



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> : <b>H04L 12/56, H04Q 7/22</b>	<b>A1</b>	(11) International Publication Number: <b>WO 00/48365</b>
		(43) International Publication Date: 17 August 2000 (17.08.00)

(21) International Application Number: PCT/SE00/00198

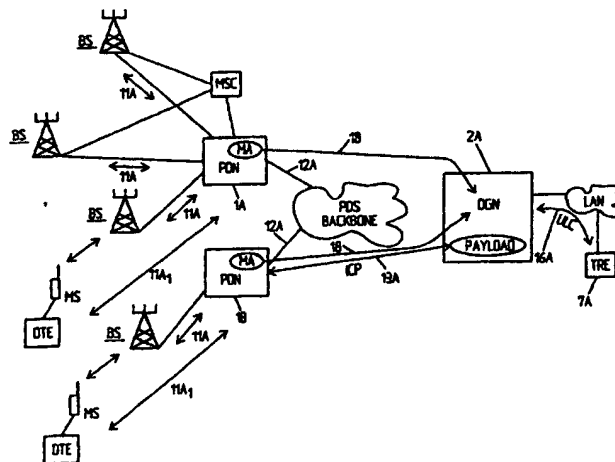
(22) International Filing Date: 2 February 2000 (02.02.00)

(30) Priority Data:  
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Box 53047, S-400 14 Göteborg (SE).(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG,  
BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE,  
ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP,  
KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,  
MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU,  
SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG,  
UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS,  
MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ,  
BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE,  
CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC,  
NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA,  
GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.

(54) Title: PROTOCOL CONVERSION USING A VIRTUAL DISTRIBUTED NODE



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Title:

PROTOCOL CONVERSION USING A VIRTUAL DISTRIBUTED NODE

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FIELD OF THE INVENTION

The present invention relates an arrangement, and a method, in a packet data communication system of connecting an end user local  
10 network and a packet data communication network. Particularly the invention relates to a network structure in a packet data communication system. The invention further relates to a packet data communication system including such arrangement(s) or a packet data communication system with a network structure for  
15 interconnecting local networks and a packet data communication network.

STATE OF THE ART

Cellular communication systems which, in addition to support  
20 communication of speech and a circuit switched data, also support communication of packet data are receiving more and more attention and several such systems are known. The GSM (Global System for Mobile Communication) system supports communication of packet data through the General Packet Radio Service (GPRS). Also the PDC-  
25 system (Personal Digital Communications) provides for packet data communication support through the PPDC (Packet PDC). Another such packet data communication service which is intended for the AMPS system is CDPD.

30 The GPRS of GSM uses a packet mode technique both for transfer of data and signalling and GPRS radio channels are defined which can be flexibly allocated. Time slots in a TDMA (Time Division Multiple Access) frame are shared by the users that are active and

uplink and downlink are allocated separately. In GPRS as well as in other packet data communication supporting systems nodes are introduced for the management of packet data communication and in the present application such nodes are called packet data nodes.

5 In GPRS the packet data node is called the serving GPRS support node (SGSN) which is at the same hierarchical level as an ordinary MSC (Mobile Switching Center) and it keeps track of the locations of individual mobile subscriber stations, performs security functions and access control. The SGSN is connected to the base  
10 station system (BSS) with frame relay. Another node is also provided in GPRS, the so called gateway GSN (GGSN) which provides for interworking with external packet switched networks and it is connected with SGSN via an IP-based GPRS backbone network.

15 For interconnecting a packet data communication network and for example a local area network of an end user expensive and complicated solutions are needed. Particularly specific routing equipment the only purpose of which is to connect an end user LAN with a packet data supporting network such as GPRS is needed. Such  
20 a router has to be supplied either by the end user himself or, as is mostly the case, by the GPRS operator. This is an expensive solution for the operator and furthermore it does not provide for any efficient scalability. According to the known solution a router is supplied for example by the operator and there has to be  
25 a link to the user from the GPRS system on which a tunnel protocol must run in order to enable the use of end user private IP addressing towards a mobile station. If Internet access is wanted, there has to be a link from GPRS to an Internet Service Provider and another router from Internet towards the end user  
30 communicating with a further router as referred to above providing a link to Internet from the end user. From SGSN and to GGSN, as defined above, there is a physical link via the GPRS backbone and a GTP (GPRS tunnelling protocol e.g. described in GSM 09.60 Vers.

5.0.0, Draft TS 100, 960 Vers. 5.0.0 (1998-01) by ETSI (European Telecommunications Standard Institute)) link is used from SGSN to GGSN. The solution is centralised and it requires extra tunnelling to the LAN of the end users, thus a tunnel runs from a GGSN to a tunnel device, the tunnel end point of which has to be reachable through use of public IP addressing or by use of GPRS operator supplied addressing. This is a requirement since otherwise the tunnel end point can not be reached from the GGSN. If routing is provided through Internet, encryption requirements may be imposed.

The tunnel ends with a tunnel end point device which may be end user supplied or operator supplied and it runs an unspecified tunnel protocol which may include encryption. This is managed by the end user in turn communicating with the end user equipment which in turn communicates with the mobile station.

The known centralised solution is even more disadvantageous if the end users use private IP addressing schemes. In addition to the high costs of equipment for the operator, a lot of physical space is needed which in turn also is expensive and unpractical for the operator. Still further, since the equipment is centralised, the impact will be very large in case of functional disturbances. It is also a drawback that the operator is dependent on routing equipment which involves high costs.

## SUMMARY OF THE INVENTION

What is needed is therefore an arrangement for interconnecting an end user local network and a packet data communication network which facilitates the provision of interconnection for the operator and through which a simple and cheap solution can be provided for the operator. Still further an arrangement is needed which enables a high degree of scalability of the system. Still further an arrangement is needed which does not require the operator to buy and pay for expensive and space demanding

equipment which often only can be used for the particular dedicated purposes. Still further an arrangement is needed which removes the drawbacks of the hitherto known solutions which are centralised leading to severe impacts in the case of functional disturbances etc. Particularly an arrangement is needed through which the buying of dedicated equipment can be avoided to a high degree for the operator. An arrangement is also needed through which the structure is simplified also when end users use private IP addressing schemes.

Particularly an arrangement is needed through which the costs for the total system can be reduced and which enables a simple solution solving end user IP address overlapping in case IP addressing schemes are used. Particularly an arrangement is needed through which the costs can be reduced for the operator and in practice also for the customers since they will pay for what they actually use.

A cellular communication system supporting packet data communication having a network structure allowing an interconnection of the packet data network and end user networks fulfilling the aims as discussed above is also needed.

Still further a method of interconnecting a packet data communication network and an end user local network fulfilling the above discussed objects is also needed.

Therefore an arrangement for interconnecting an end user local network and a packet data communication network comprising a packet data network backbone, is provided, at least comprising one packet data node with a serving functionality for handling packet data communication, the arrangement further including a gateway functionality for providing communication with external networks.

It comprises at least one virtual distributed node which provides the gateway functionality. The virtual distributed node comprises an interworking node device including converting means for converting between a communication protocol for local network end user communication which uses a user level data packet format and an internal packet data protocol using an internal packet data format. The virtual distributed node includes a management functionality for managing the interworking node device. This management functionality is executed in, or localized to, a packet data node with a serving functionality and the packet data network is used for communication. Thus the gateway functionality is moved to the interworking node device which generally is provided by the user and the management thereof is provided through the serving packet data node. The management functionality particularly comprises a management system which executes in a serving packet data node. The management functionality can be provided and executed in a number of serving packet data nodes and a plurality of serving packet data nodes may also be able to manage a plurality of interworking node devices for reasons of redundancy. In a most advantageous embodiment the virtual distributed node/nodes is/are managed by the operator of the packet data communication system. The management can of course also be handled in other manners, but operator management provides for a particularly advantageous implementation.

A public or third party data communication network such as for example Internet may also be integrated with the packet data communication system backbone network as an interconnect or as an interconnecting data network.

According to different embodiments the internal packet data frames may be, or require being, encrypted. In that case the interworking node device has to convert the internal packet data frames to/from

user level packet data frames, thus also handling the encryption. Encryption is particularly needed if a part of the network is a public or third party data communication network such as Internet. The encrypted frames may be so called IP-sec-frames. This is particularly the case when an end user uses a private IP addressing scheme, the external network being Internet. The same is of course applicable in case the public or third party data communication network is some other network than Internet or an intranet.

The inventive concept can be implemented for different cellular communication systems including a packet data communication supporting functionality such as for example GPRS. In that case the packet data node with a serving functionality is the so called serving GPRS support node SGSN. This node is connected to a base station subsystem BSS and the internal packet data communication protocol that is used is the GTP protocol. The virtual distributed node providing the gateway functionality can thus be said to replace the network gateway node GSN, also called GGSN. According to the present invention the virtual distributed node including the interworking node device, which is managed from a SGSN, thus replaces the conventional GGSN, the management of the entire system still, in an advantageous implementation, being handled by the operator, the interworking node device, however, physically and financially being taken over by the end user.

In an alternative embodiment the packet data communication system is packet PDC, PPDC, in which case the serving packet data node is a packet-mobile switching center, P-MSC. In still another implementation the concerned system is the CDPD as discussed above. Of course the invention is also applicable to any other packet data system using a network structure which is similar to



what has been described above, including serving and gateway node types, such as for example the GPRS structure.

5 The inventive concept can e.g. also be implemented in UMTS (Universal Mobile Telephone System). In an alternative implementation the virtual distributed node or nodes is/are managed by the end user.

10 Therefore also a cellular communication system supporting packet data communication which comprises a number of packet data nodes with a serving functionality for handling packet data communication, communicating with the base station subsystem, and including a gateway functionality for providing communication with external data networks is provided. The system also provides for  
15 communication with end user local networks. The communication system comprises a number of virtual distributed nodes providing a gateway functionality and comprising an interworking node device which includes converting means for converting between a communication protocol for local network end user traffic, which  
20 protocol uses a user level data packet format, and an internal packet data protocol using an internal packet format. Each virtual distributed node is also provided with a management functionality for managing the interworking node device. Said management functionality for a number of interworking node devices, i.e. one  
25 or more, is executed in a number of packet data nodes comprising a serving functionality. The packet data network backbone is used for communication. According to different embodiments the management functionality is provided in a plurality of serving packet data nodes for managing at least one interworking node  
30 device, i.e. a plurality of serving packet data nodes may all be able to manage one interworking node device for redundancy reasons or one serving packet data node may be able to manage one or more interworking node devices or a plurality of interworking node

devices as well as one interworking node device either may be manageable from one packet data node with a serving functionality or by a plurality of packet data nodes with a serving functionality. The solution may be the same throughout the system or different solutions may be implemented over the system, for example taking into consideration the redundancy needed at the actual location.

Advantageously the virtual distributed nodes are managed by the operator of the cellular communication system supporting packet data communication. In a particular implementation a public or third party data communication network is integrated with the cellular communication system supporting packet data communication the backbone network acting as an interconnecting data network. The public or third party data communication network may for example be Internet. Intranets may also be integrated in a similar manner.

In a particular implementation a number of internal packet data frames provided to a number of interworking node devices for conversion are encrypted, e.g. because of an external data communication network being connected. The interworking node device does then convert said internal packet data frames to (and from) user level packet data frames for end user communication. Systems implementing the inventive concept may for example be GPRS, PPDC, CDPD, UMTS etc., the main thing being that the structure is such that it needs nodes with a serving functionality and a gateway functionality.

A method of interconnecting an end user local network and a packet data communication network comprising a packet data network backbone is therefore also provided. The packet data communication network comprises a number of packet data nodes including a

serving functionality and it also includes a gateway functionality for external communication. The method includes the steps of; introducing an interworking node device to provide a gateway functionality; executing the management of said interworking node device in a number of packet data nodes having a serving functionality; using an internal data communication protocol for communication between a packet data node with a serving functionality and an interworking node device; using a communication protocol for communication between the interworking node device and the end user of a local network, e.g. a Local Area Network (LAN), in said interworking node device converting between the end user communication protocol and the internal data communication protocol so that communication between a packet data node with a serving functionality and an end user local network can take place without the use of specific tunnelling protocols and intermediate, centralised, routing means.

Particularly the method includes the step of managing an interworking node device from a plurality of packet data nodes for reasons of redundancy. Even more particularly the method includes the step of managing a plurality of interworking node devices from one and the same packet data node with a serving functionality. Most particularly the method includes the step of providing for managing of the interworking node devices, or the virtual gateway nodes, by the operator of the packet data communication system. In an advantageous implementation the method includes the steps of integrating a public or third party data communication network, such as for example Internet, or intranets, as interconnecting external networks. The method can be implemented in different packet data communication systems such as GPRS, PPDC or CDPD etc. as referred to above.

It is an advantage of the invention that a decentralised solution is used, thus reducing the consequences of malfunctions etc. It is also an advantage of the invention that the equipment can be customized and provided by the customer, on the customer premises  
5 and also physically located at the end user's desired location and still it particularly may be handled or managed by the operator of the packet data system. Also a number of other advantages are provided for of which a number already have been described earlier in the application.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will in the following be further described in non-limiting way and with reference to the accompanying drawings in which:

5

Fig. 1 shows a prior art network structure which is illustrated for explanatory reasons,

10

Fig. 2 shows an example of an implementation of the present invention to a packet data system,

Fig. 3 is a figure similar to Fig. 2 schematically illustrating an implementation to GPRS, and

15

Fig. 4 shows a particular embodiment of an implementation of the invention to GPRS.

## DETAILED DESCRIPTION OF THE INVENTION

20

For explanatory reasons and in order to explain the functioning and the advantages of the inventive arrangement a prior art network structure which relates to GPRS is illustrated in Fig. 1. Two SGSNs 1<sub>0</sub> are connected to base station subsystems, BSS. In the figure also a combined SGSN/GGSN, i.e. a node which includes both the functionality of a SGSN and the functionality of a GGSN 1<sub>co</sub> is illustrated. The SGSNs 1<sub>0</sub> communicate with GGSNs 2<sub>0</sub>, 2<sub>0</sub> via physical links 12<sub>0</sub> which run via the GPRS backbone. There is also a physical link 12<sub>0</sub> to the combined SGSN/GGSN via the GPRS backbone. The GGSN nodes 2<sub>0</sub>, 2<sub>0</sub> and the combined SGSN/GGSN include the management functionality MA for the payload traffic. To provide for communication or connection with an end user LAN or a traffic end point, which is the end user equipment that communicates with the mobile station, (not shown) routing devices RO 3<sub>0</sub> are supplied either by the end user or the by the GPRS

30

operator, which generally is the case. There is a link 14<sub>0</sub> to the end user from the GPRS system. On this link a tunnel protocol has to be run in order to enable the use of end user private IP addressing towards the mobile station (not shown). The tunnel or the tunnel protocol 15<sub>0</sub> runs from a GGSN 2<sub>0</sub> to a tunnel device or a tunnel end point TE 4<sub>0</sub> which has to be reachable through the use of public IP addressing or by use of GPRS operator supplied addressing. Otherwise the TE 4<sub>0</sub> can not be reached from the GGSN 2<sub>0</sub>. It can be routed through Internet. Then however encryption may be required. The tunnel end point TE 4<sub>0</sub> is, as referred to above, the end point of the tunnel 15<sub>0</sub> and it is an end user (or GPRS operator) supplied device that uses an unspecified tunnel protocol 16<sub>0</sub> (possible with encryption), which is managed by the end user. The traffic end point TRE 7<sub>0</sub> is, as referred to above, the end user equipment communicating with the mobile station. Links 14<sub>1</sub> are provided from the GGSN 2<sub>0</sub> and the combined SGSN/GGSN 1<sub>00</sub> from GPRS to an Internet Service Provider ISP 5<sub>1</sub> for Internet access. A routing device ROX 6<sub>1</sub> is provided and it is used from Internet towards the end user. 16<sub>1</sub> indicates the link from the end user to Internet over a routing device 3<sub>0</sub>'. 13<sub>0</sub> illustrates the GTP link used from SGSN to GGSN. Thus, for the known solution routing devices are required meaning that the operator has to provide for a GGSN and a router and it also presupposes a tunnel end point.

Fig. 2 shows the implementation of the inventive concept to a packet data system PDS in general, as long as it includes serving and gateway node functionality.

The inventive concept in general terms consists in the introduction of a virtual gateway packet data node which is built in a distributed way and which comprises a DGN (an interworking node device) 2A and a management system MA executing in a packet data node 1A, 1B. Fig. 2 shows two packet data nodes PDN 1A, 1B

communicating with base stations BS using a communication protocol 11A. Since the communication system in this case also supports communication of speech and circuit switched data, it comprises a number of mobile switching centers MSC in a conventional manner and of which only one is illustrated. According to different embodiments payload and management come from different nodes, or from the same, the management may be implemented in a number of nodes to provide for redundancy, various alternatives being possible. The DGN may also be network connected.

In Fig. 2 a mobile station MS is illustrated which is connected to a digital terminal equipment DTE. MS communicates via radio link with a BS. A communication protocol 11A<sub>1</sub> is also illustrated for communication between PDN 1A, 1B and an MS respectively. Information of mobile subscriber stations is kept in the respective PDN 1A; 1B which also provides for multiplexing, compression, access control etc. and the communication protocol 11A<sub>1</sub> is virtual and "holds" packets together sent to/from the same destination. The interworking node device DGN 2A is capable of receiving internal communication protocol (ICP) frames and it includes converting means for converting said ICP frames sent over the ICP link 13A. There are also physical links 12A from PDN 1A, 1B via the PDS backbone to the DGN 2A. The management system MA executing in PDN 1A, 1B manage DGN 2A via 18 and as can be seen, in this embodiment one and the same DGN 2A can be managed both by PDN 1A and PDN 1B for redundancy reasons. In DGN 2A the ICP frames are converted to user level frames of a user level protocol ULC communicating over link 16A with the traffic end point (TRE) 7A. Thus, in the converting means in DGN 2A the conversion is performed between ICP frames and ULC frames and the ULC frames are passed on and off the users LAN to the traffic end point TRE 7A.

Advantageously DGN 2A is managed by the packet data communication operator. Thus, as can be seen from the figure, the internal communication protocol ICP can be used on the way to the DGN 2A which is, advantageously, provided by, and located with, the customer, thus requiring no routing device and extra tunnelling. If the ICP frames are encrypted, for example so called IP-sec-frames, DGN is also able to handle them. Encryption is however optional and depends on the particular implementation, whether Internet is an interconnect or not etc.

Fig. 3 shows an embodiment of the invention as implemented to GPRS. A packet data node here comprises a serving GPRS support node SGSN communicating with the base station controller BSC which in turn communicates with a number of base transceiver stations BTS. The SGSN 1C communicates with the BSC via a communication protocol 11B which here for example is the BSS GPRS protocol BSSGP. The SGSN is at the same hierarchical level as an MSC (no MSC is illustrated in this figure) and it keeps track of the locations of individual MSs, performs security functions and access control. The SGSN 1C is connected to BSS with frame relay. SGSN 1C is connected to DGN 2B via the GPRS backbone network and an internal communication protocol 13B; 13C is used for communication between SGSN 1C and DGN 2B, 2C respectively. The internal communication protocol is here advantageously the GTP protocol. The GTP protocol is described in GSM 09.60, version 5.0.0, draft TS 100,160 V 5.0.0 (1998-01) by ETSI, (European Telecommunication Standards Institute) which herewith is incorporated herein by reference. The general packet radio service GPRS is further described in GSM 03.60, version 5.2.0 (1997-12), by ETSI, and it is also incorporated herein by reference. The DGNs 2B; 2C are managed by the management functionality executing in SGSN 1C via communication links 18. It does not have to be separate physical links for the management and the payload traffic



as illustrated in the figure (cf. e.g. 13C and 18) but one and the same physical interface may be used. This is also applicable for Fig. 2 and Fig. 4. In this embodiment is illustrated in a simplified manner that two DGNs (or more of course) are managed by one and the same SGSN. However, this does not have to be the case, but it shows an advantageous implementation. Also more than two DGNs may be managed by one and the same SGSN etc. just as one or more of the DGNs may be managed from two or more SGSNs for redundancy reasons. In DGN 2B; 2C a conversion is performed between GTP frames and user level frames of the user level communication protocol ULC 16B to the traffic end points TRE 7B; 7C of the end user LANs. Thus, in a particular embodiment DGN 2B; 2C is capable of receiving GTP frames, which may be encrypted or not, and if encrypted, probably so called IP-sec frames, and of converting the GTP frames to for example IP frames and passing the IP frames on and off the end users LAN. Advantageously DGN 2B; 2C is managed by the operator of GPRS.

Fig. 4 again shows an implementation to GPRS. SGSNs 1D, 1E, 1F are connected to BSS in a conventional manner. SGSN 1D, 1E, 1F all include the execution of a management functionality which forms a part of a virtual GGSN which also comprises DGNs 2D, 2E and 2F respectively. The management of DGNs 2D, 2E and 2F respectively is handled via links 18 as more thoroughly described with reference to Fig. 3. Again the GTP protocol is used as an internal communication protocol 13C, 13D, 13E which is used for the payload traffic. As described above, in DGN 2D and 2E respectively a conversion is done to/from the user level communication protocol ULC 16D, 16E to the traffic end point TRE of the end user LAN.

However, in this case a router ROX 6<sub>1</sub>, which may be supplied either by the end user or by the GPRS operator and which is the router used to Internet Service Provider ISP 5<sub>1</sub> which communicates

with a router ROX<sub>1</sub> 6<sub>2</sub> which is a router used from Internet towards the end user communicating with the DGN 2F, which in turn provides for conversion between the internal communication protocol GTP 13E and the user level communication protocol 16F from DGN 2F to traffic end point TRE 7E. As can be seen, the end point of the GTP tunnel goes all the way to the DGN 2D, 2E and 2F respectively in each case wherein the conversion takes place and as can be seen no GGSN is required as well as no routing devices are required to be provided by the operator and still further no extra tunnelling is needed to the end user LAN. Since the DGNs are provided by the end user they are particularly adapted to the specific needs and requirements of the end user. This also assists in making the solution decentralised and, in comparison with hitherto known structures, insensitive to faults in that the consequences thereof will be much less serious.

The invention is of course not limited to the explicitly illustrated embodiments, but it can be varied in a number of ways within the scope of the claims.

## CLAIMS

1. An arrangement for interconnecting an end user local network  
5 and a packet data communication network comprising a packet data  
network backbone, at least one packet data node  
(1A,1B;1C;1D,1E,1F) with a serving functionality for handling  
packet data communication, and further comprising a gateway  
10 functionality for providing communication with external  
network(s),

c h a r a c t e r i z e d i n

that it comprises at least one virtual distributed node providing  
a gateway functionality and comprising an interworking node device  
(2A;2B,2C;2D,2E,2F) comprising converting means for converting  
15 between a local network end user communication protocol comprising  
a user level data packet format and an internal packet data  
communication protocol using an internal packet data format and in  
that said virtual distributed node includes a management  
functionality for managing the interworking node device  
20 (2A;2B,2C;2D,2E,2F), which management functionality is executed in  
a packet data node (1A,1B;1C;1D,1E,1F), and wherein the packet  
data network backbone is used for communication.

2. An arrangement according to claim 1,

5 c h a r a c t e r i z e d i n

that the management functionality (MA) comprises a management  
system executing in a serving packet data node  
(1A,1B;1C;1D,1E,1F).

0 3. An arrangement according to claim 2,

c h a r a c t e r i z e d i n

that the management functionality (MA) is provided and executed in  
a number of serving packet data nodes (1A,1B;1C;1D,1E,1F).

4. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that a number of serving packet data nodes (1A,1B;1C;1D,1E,1F)  
5 comprises a management functionality (MA) to manage a plurality of  
interworking node devices (2A;2B,2C;2D,2E,2F).
5. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
10 that the virtual distributed node(s) is/are managed by the  
operator of the packet data communication system.
6. An arrangement according to any one of claims 1-4,  
c h a r a c t e r i z e d i n  
15 that the virtual distributed node(s) is/are externally managed  
(from the outside of the system).
7. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
20 that a public or third party data communication network such as  
e.g. Internet is integrated with the packet data communication  
system backbone network as an interconnecting data network.
8. An arrangement according to any one of the preceding claims,  
25 c h a r a c t e r i z e d i n  
that the internal packet data frames of the internal communication  
protocol are encrypted and in that the interworking node device  
converts said internal packet data frames to/from user level  
packet data frames.
- 30 9. An arrangement according to claim 8,  
c h a r a c t e r i z e d i n  
that the encrypted frames are IP-sec-frames.

10. An arrangement at least according to claim 7,  
c h a r a c t e r i z e d i n  
that at least a number of end user(s) use(s) an overlapping IP-  
5 addressing scheme, the external data network being Internet.

11. An arrangement according to any one of claims 1-4,  
c h a r a c t e r i z e d i n  
that the distributed node(s) is/are managed by the end user(s).  
10

12. An arrangement according to any one of the preceding claims,  
c h a r a c t e r i z e d i n  
that the packet data communication system is GPRS and in that the  
packet data node is a serving GPRS support node (SGSN) connected a  
15 base station subsystem (BSS) and in that the internal packet data  
communication protocol is GTP.

13. An arrangement according to any one of claims 1-11,  
c h a r a c t e r i z e d i n  
20 that the packet data communication system is P-PDC, the serving  
packet data node being a packet-mobile switching center (P-MSC).

14. An arrangement according to any one of claims 1-11,  
c h a r a c t e r i z e d i n  
25 that the packet data communication system is CDPD or UMTS.

15. A cellular communication system supporting packet data  
communication and comprising a number of packet data nodes  
(1A,1B;1C;1D,1E,1F) with a serving functionality for handling  
30 packet data communication and communicating with a base station  
system and with end user local networks, a gateway functionality  
being provided for the provision of communication with the  
external data network(s),

c h a r a c t e r i z e d i n

that it comprises a number of virtual distributed nodes each providing said gateway functionality and each comprising an interworking node device (2A;2B,2C;2D,2E,2F) including converting

5 means for converting between a communication protocol for local network end user traffic which protocol comprises a user level data packet format (ULC) and an internal packet data network protocol using an internal packet data format (ICP), and in that each virtual distributed node comprises a management functionality  
10 for managing the interworking node device (2A;2B,2C;2D,2E,2F), which management functionality for a number of interworking node devices is executed in a number of packet data nodes providing said serving functionality and in that the packet data network backbone is used for communication.

15

16. A cellular communication system according to claim 15,

c h a r a c t e r i z e d i n

that the management functionality (MA) is provided in a plurality of serving packet data nodes (1A,1B;1C;1D,1E,1F) for managing at  
20 least one interworking node device (2A;2B,2C;2D,2E,2F).

17. A cellular communication system according to claim 15 or 16,

c h a r a c t e r i z e d i n

that at least one of the serving packet data nodes  
25 (1A,1B;1C;1D,1E,1F) comprises a management functionality (MA) managing a plurality of interworking node devices (2A;2B,2C;2D,2E,2F).

18. A cellular communication system according to any one of claims  
30 15-17,

c h a r a c t e r i z e d i n

that the virtual distributed nodes are managed by the operator of the cellular communication system supporting packet data communication.

5 19. A cellular communication system according to any one of claims 15-18,

c h a r a c t e r i z e d i n

that a public or third party data communication network such as Internet is integrated with the cellular communication system  
10 supporting packet data communication backbone network as an interconnecting data network.

20. A cellular communication system according to any one of claims 15-18,

15 c h a r a c t e r i z e d i n

that a number of internal packet data frames provided to a number of interworking node devices (2A;2B,2C;2D,2E,2F) for conversion, are encrypted and in that interworking node device(s) convert said internal packet data frames to/from user level packet data frames.

20

21. A cellular communication system according to any one of claims 15-20,

c h a r a c t e r i z e d i n

that it is GPRS, PPDC, CDPD or UMTS or a similar communication  
25 system supporting packet data communication.

22. A method of interconnecting an end user local network and a packet data communication network comprising a packet data network backbone and a number of packet data nodes including a serving  
30 functionality for handling packet data communication and a gateway functionality for communication with external networks,

c h a r a c t e r i z e d i n

that it comprises the steps of:

22

- introducing a number of interworking node device(s) (2A;2B,2C;2D,2E,2F) providing a gateway functionality,
- executing the management of said interworking node device(s) (2A;2B,2C;2D,2E,2F) in a number of packet data nodes (1A,1B;1C;1D,1E,1F) including a serving functionality,
- using an internal data communication protocol (ICP;GTP) for communication between a packet data node (1A,1B;1C;1D,1E,1F) with a serving functionality and an interworking node device (2A;2B,2C;2D,2E,2F),
- using an end user communication protocol (ULC) for communication with an end user of a local network,
- in said interworking node device (2A;2B,2C;2D,2E,2F) converting between the end user communication protocol (ULC) and the internal data communication protocol (ICP;GTP) so that communication between a packet data node with a serving functionality and an end user can take place using the internal communication protocol from the packet data node (1A,1B;1C;1D,1E,1F) to the interworking node device (2A;2B,2C;2D,2E,2F).

23. A method according to claim 22,

characterized in

that it further comprises the step of:

- managing said interworking node device(s) from a plurality of packet data nodes (1A,1B;1C;1D,1E,1F) including a serving functionality.

24. A method according to claim 22 or 23,

characterized in

that it further comprises the step of:

- managing a plurality of interworking node devices from one and the same packet data node, including a serving functionality.



25. A method according to any one of claims 22-24,

c h a r a c t e r i z e d i n

that it further comprises the step of:

- integrating a public or third party data communication network

5 such as for example Internet as an interconnecting external network.

26. A method according to any of claims 22-25,

c h a r a c t e r i z e d i n

10 that it further comprises the step of:

- managing the interworking node device by the operator of the packet data communication system or externally.

27. A method according to any one claims 22-26,

15 c h a r a c t e r i z e d i n

that the packet data communication system is GPRS, the packet data node with a serving functionality being a SGSN and the interworking node device and the management functionality thereof is comprised by a virtual gateway GSN, the internal protocol

20 further being GTP.



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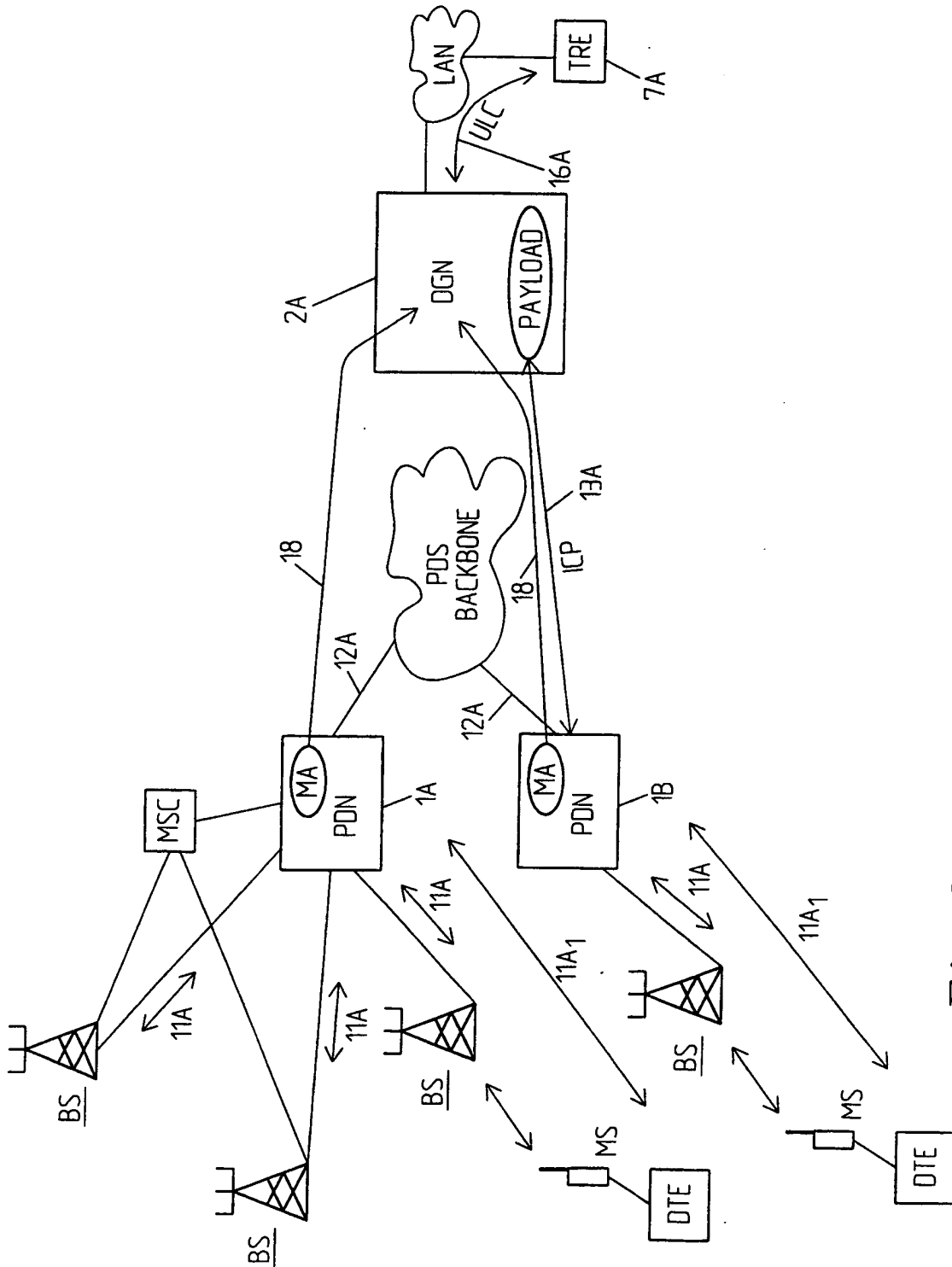


Fig. 2

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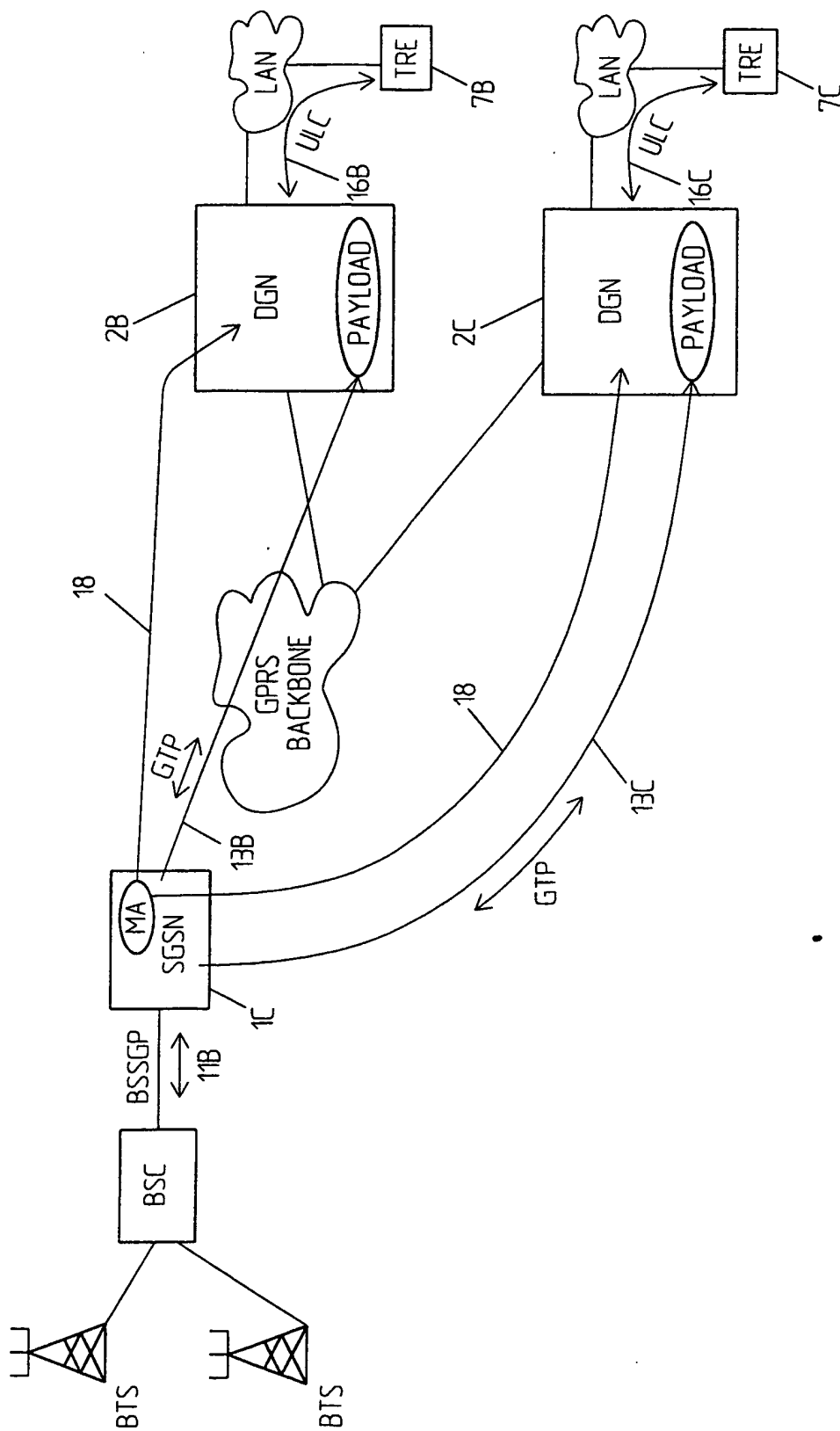


Fig. 3

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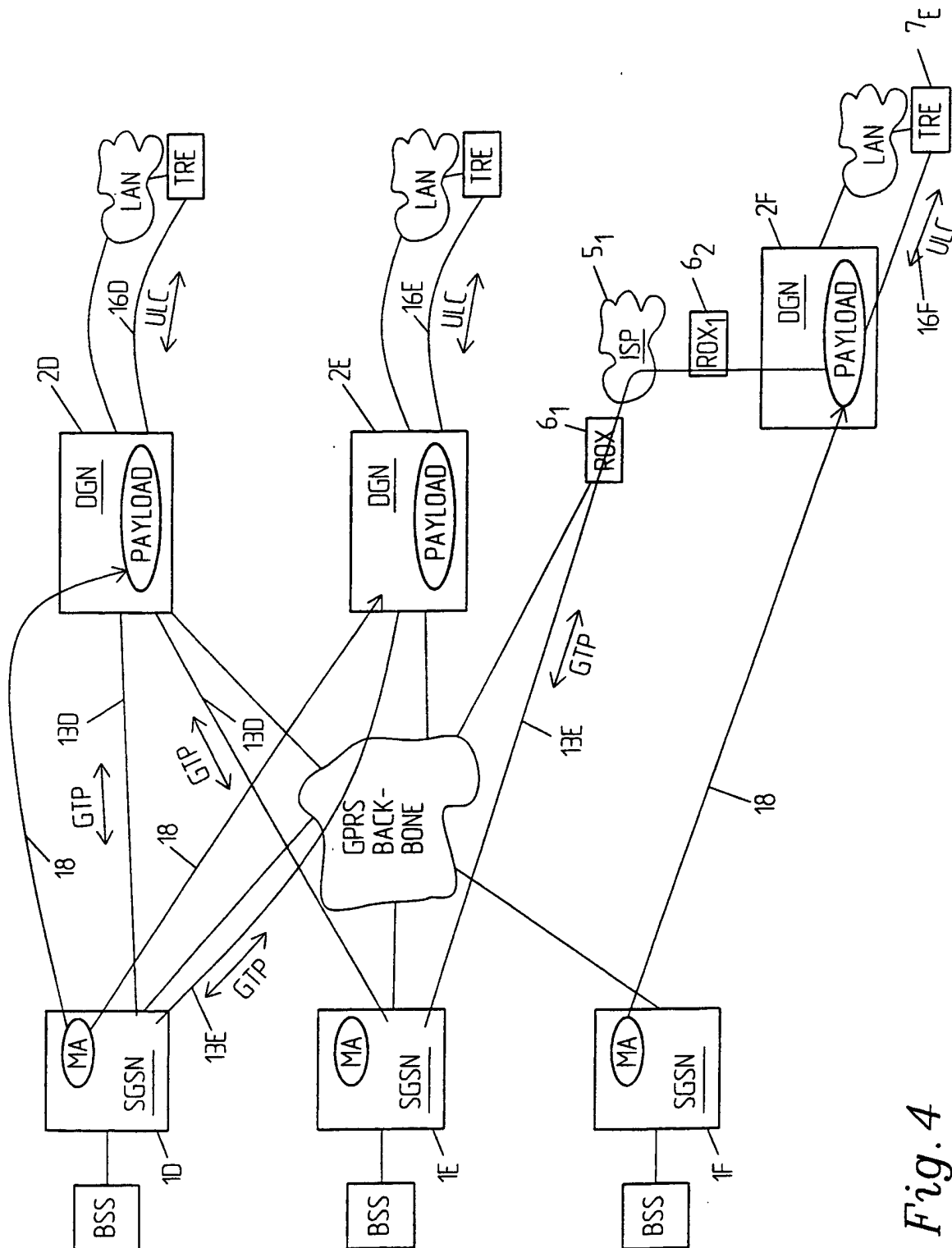


Fig. 4

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/00198

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 12/56, H04Q 7/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9858517 A1 (NORTHERN TELECOM LIMITED), 13 December 1998 (13.12.98), page 1, line 26 - page 2, line 12; page 3, line 9 - line 22, figure 2 --	1-27
A	WO 9817048 A1 (BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY), 23 April 1998 (23.04.98), page 1, line 21 - line 30; page 2, line 6 - line 8; page 4, line 6 - line 9, figures 2,3, page 5, line 6 - line 16 --	11

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"F" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

3 May 2000

Date of mailing of the international search report

18-05-2000

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 00/00198

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9722936 A1 (MOTOROLA INC.), 26 June 1997 (26.06.97), page 1, line 21 - line 28; page 7, line 14 - line 32; page 10, line 1 - line 5, figure 2, claim 7, page 12, line 1 - line 7; page 11, line 14 - line 25 --	5,12-14,21, 26
A	WO 9702670 A (NOKIA TELECOMMUNICATIONS), 23 January 1997 (23.01.97), figures 6,8, abstract --	5,12-14,21
A	EP 0821507 A2 (LUCENT TECHNOLOGIES INC.), 28 January 1998 (28.01.98), column 2, line 49 - line 54, abstract --	1-27
A	US 5771353 A (G. EGGLESTON ET AL), 23 June 1998 (23.06.98), column 2, line 24 - line 44, figure 2 -- -----	1-27

# INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.

PCT/SE 00/00198

Patent document cited in search report			Publication date	Patent family member(s)		Publication date
WO	9858517	A1	13/12/98	GB	2326306 A	16/12/98
				GB	9712340 D	00/00/00
WO	9817048	A1	23/04/98	AU	4630597 A	11/05/98
				EP	0932972 A	04/08/99
				GB	9621524 D	00/00/00
WO	9722936	A1	26/06/97	CA	2216533 A	26/06/97
				GB	2314729 A	07/01/98
				GB	9718194 D	00/00/00
WO	9702670	A	23/01/97	AU	6306796 A	05/02/97
				EP	0882336 A	09/12/98
				FI	98587 B,C	27/03/97
				FI	953336 A	07/01/97
EP	0821507	A2	28/01/98	CA	2206988 A	24/01/98
				JP	10091551 A	10/04/98
				US	5894478 A	13/04/99
US	5771353	A	23/06/98	US	5764899 A	09/06/98
				US	5958006 A	28/09/99